DOCUMENT RESUME

ED 305 248 SE 050 453

AUTHOR	Baird, William E.; And Others
TITLE	Correlates of Student Performance in the Science Olympiad: The Test of Integrated Process Skills and Other Variables.
PUB DATE	89
NOTE	16p., Paper presented at the Annual Meeting of the National Association for Research in Science Teaching (62nd, San Francisco, CA, March 30-April 1, 1989).
PUB TYPE	Reports - Descriptive (141) -- Reports - Research/Technical (143) -- Speeches/Conference Papers (150)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	*Educational Games; *Problem Solving; Process Education; Science Activities; Science Instruction; Science Interests; Science Tests; Scientific Concepts; *Scientific Literacy; Scientific Methodology; Secondary Education; *Secondary School Science; *Secondary School Students; Technological Literacy
IDENTIFIERS	*Science Olympiad; Test of Integrated Process Skills

ABSTRACT

The Test of Integrated Process Skills (TIPS) was administered to 667 students in grades 9-12 who were registering to participate in a regional science Olympiad on a southern university campus in February 1988. Each student's score on the test was correlated with subsequent performance in one or more of the 11 Olympiad events. Of the 667 students who participated in the Olympiad, 404 had usable scores on the TIPS. Five of the 22 events produced Spearman rank-order correlations with TIPS scores which were significant. These events were Bio-Process Lab, Designer Genes; Measurement Lab, Periodic Table Quiz, and Science Bowl. An additional three events (A is for Anatomy, Topographic Map Reading, and The Pentathlon) produced significant correlations. Descriptions of scoring criteria for events which produced significant correlations provide limited support for the predictive validity of the TIPS in forecasting student performance in skills based science competitions such as the Olympiad. Results indicate that type of school, number of previous Olympiads attended, and number of science courses completed produce significant correlations with rankings in some Olympiad events. No significant correlations were found between age, race, grade level, and student enrollment in school with rankings in any Olympiad events. (Author/MVL)

Correlates of Student Performance in the Science Olympiad: The Test of Integrated Process Skills and Other Variables

William E. Baird
Department of Curriculum and Teaching

W. D. Perry
Department of Chemistry

Marllin Simon
Department of Physics

Auburn University
Auburn, Alabama 36849

Paper presented at the annual meeting of the
National Association for Research in Science Teaching
San Francisco, CA
March 31, 1989

Abstract

A regional Science Olympiad was conducted on a Southern university campus in February, 1988, with forty secondary schools sending teams of up to 15 students. Of the 667 students in grades 9 - 12 who participated in the Olympiad, 404 had usable scores on the Test of Integrated Process Skills (TIPS). The TIPS is designed to measure competency in the process skills of (1) stating and revising hypotheses, (2) identifying and controlling variables, (3) operationally defining critical terms, (4) graphing and interpreting data, and (5) designing an experiment. Each student's score on the TIPS was correlated with subsequent performance in one or more of the 22 Olympiad events. Team average TIPS scores were highly predictive of total team points earned in the Olympiad. Student rankings in five of the 22 events produced Spearman rank-order correlations with individual's TIPS scores which were significant at the .01 level. These events were Bio-Process Lab, Designer Genes, Measurement Lab, Periodic Table Quiz and Science Bowl. An additional three events - A is for Anatomy, Topographic Map Reading and The Pentathlon - produced correlations at the .05 level of significance. Descriptions of scoring criteria for events which produced significant correlations provides limited support for the predictive validity of the TIPS in forecasting student performance in skills-based science competitions such as the Olympiad. Additional student demographic data were collected. Results indicate that type of school, number of previous Olympiads attended, and number of science courses completed produce significant correlations with rankings in some Olympiad events. No significant correlations were found for age, race, grade level, and student enrollment in school with rankings in any Olympiad events.

Purpose of the Study

Can pencil-and-paper test scores be used to predict student success in subsequent science process skill events? Do scores on the Test of Integrated Process Skills (TIPS) (Dillashaw and Okey, 1980) correlate with individual and team performance in the Science Olympiad? Which event rankings correlate most significantly with scores on the TIPS? Are the events with the highest correlations those most likely to require that students use one or more of the integrated science process skills reportedly measured by the TIPS? Can demographic variables such as age, sex, GPA, type of school, and frequency of science labs be used to predict Olympiad performance? Is the predictive value of the TIPS equal to or better than these demographic variables? Which demographic variables correlate best with Olympiad performance?

This study was designed to answer each of the above questions for a sample of 667 students in grades 9-12 who took part in a regional Science Olympiad on a southern university campus in February, 1988. The findings should be of interest to all who are concerned with the predictive validity of the TIPS. Given the nature of the Science Olympiad as a process skills-based competition among teams of secondary students, it should make a fruitful test bed for examining student "sciencing" behaviors. Correlations between demographic variables and Olympiad performance should contribute to our knowledge of the effects of learning environments on student problem solving skills.

Related Research

Using test scores to predict success in skills-based science courses is an intriguing possiblity. Sanchez. and Betkouski (1986) used multiple regression analysis to examine 16 predictors of success in general college chemistry classes. They found that scores on the TIPS ranked third in predicting final course grades in chemistry, below grade-point average and sex. The TIPS was much less useful in predicting success in lower level chemistry for allied science major, ranking only 14th. While TIPS scores accounted for 5.3% of common variance among general chemistry students, it explained only 0.10% of introductory chemistry students' final grade variance.

A number of researchers have attempted to describe relationships among science process skill levels, demographic factors and classroom instruction (Brown, 1977; Berger, 1982; Padilla, Okey and Garrard, 1984, Zeitler, 1981). In one such study, Pettus and Haley (1980) describe correlations between age, sex, grade level, and interest in science career and process skill performance levels. While none of these variables were strongly connected with process skill levels, the number of science courses completed seemed to best predict scores on the Test of Science Processes (Tannenbaum, 1971). This variable accounted for 14.7% of common variance. Fritz and Szabo (1974) reported racial differences among eighth grade students in the acquisition of science process skills using IPS and ISCS curricula materials.

There is evidence that the constructs of formal reasoning ability (Inhelder and Piaget, 1958) and integrated science process skills (Livermore, 1964) share up to 33% of common variance (Padilla, Okey and Dillashaw, 1983). A study by Baird and Borich (1987) found little evidence that these traits are orthogonal. Instead, science process skills may be influenced by other factors such as general intelligence, analytical abilities, formal reasoning level, and (to a lesser extent) classroom rehearsal (Padilla, Okey and Garrard, 1984).

The Science Olympiad places participants in situations where success depends on cooperation <u>within</u> a team while competing <u>against</u> other teams. Such cooperation within a competitive environment has been found to promote optimal problem solving performance (Johnson, et al., 1981). The effectiveness of small groups in problem solving has been the subject of study for over sixty years. Shaw (1932) studied four-member teams of graduate students given a problem situation. Each group was asked to cooperate in reaching a single correct solution to each given problem. She found that groups submitted correct solutions 53% of the time, while individuals working alone submitted only 7.9% correct solutions. Despite noting unequal participation by members in the groups, she concluded that groups hold significant advantages over individuals in problem solving situations. Johnson, et al. (1981) conducted a meta-analysis of 122 studies of individualistic, competitive, and cooperative learning groups. They found cooperative learning superior in promoting achievement over all age levels within science. They concluded that the ideal type of group arrangement seems to be "cooperation with intergroup competition" - precisely the model used by the Science Olympiad.

Procedures

Students from 40 school systems sent 49 teams to participate in the third annual regional Science Olympiad held on a Saturday in February on a southern university campus. Each team of up to 15 students had a coach - usually a science teacher. Five weeks before the Olympiad each school received a packet containing instructions for registration and description of the 22 Olympiad events. This packet also contained copies of the TIPS, a demographic profile sheet, and scan forms for students to bubble in responses. Students took the TIPS under a teacher's supervision in their own school and returned completed scan forms by mail for scoring. A total of 462 students completed and returned the TIPS instrument.

The Test of Integrated Process Skills (TIPS) This is a 36-item, multiple-choice test validated (Dillashaw and Okey, 1980) for students in grades 10 - 12. The test is designed to be taken in a single, untimed session. Items on the test assess each of the five integrated science process skills (AAAS, 1967) - stating and revising hypotheses, identifying and controlling variables, operationally defining critical terms, graphing and interpreting data, and designing an experiment. All items have four response choices, and are stated in a practical problem context. Items are drawn from all science content areas to avoid favoring any particular science background. Cronbach alpha reliability was established by Dillashaw and Okey (1980) as 0.89 with over 700 students in grades seven through twelve. Content validity was established using specific objectives judged by a panel of science educators. They found a mean score of 18.99 (s.d. 7.60) for students from general curricula in grades 7, 9 and 11. Readability index is assessed at 9.2.

The Science Olympiad Each year high school students in increasing numbers participate in the Science Olympiad. In 1988 there were 118 regional Olympiads and 30 state Olympiads. Twenty-nine states were represented at the National Science Olympiad. Students compete as individuals and/or teams in science activities designed to challenge their creative, manipulative and computational skills. This day-long series of competitive events is held first at local or regional levels. Regional events are held under the same conditions and judging criteria as state and national competition. Rules are specified by the National Science Olympiad Steering Committee in the "Coaches' Manual and Rules, Division C" (1988). Figure 1 describes each of the 22 events, number of participants constituting a team, judging criteria, and alloted time for the event. In ten of the events, individuals compete alone. Teams of two to four participants compete in the remaining events.

Events are from fifteen minutes to one hour in duration. A tally is kept of points scored by each school's team. First-place in each event is awarded 11 points, second place ten points, down to two points for tenth place. All who participate in any event receive one point, even if they fail to place in the top ten. Total points for each school's team are the sum of all points obtained by individuals and sub-teams for all events in which they have participated at the end of the day. Overall success is thus a direct result of how many events have been attempted by how many team members by the end of the Olympiad. All participation is optional. A school team may participate in as many events as individuals or sub-teams choose to enter.

Characteristics of the students A total of 667 students took part in the regional Olympiad. Only 462 usable scan forms were returned. Demographic information consists of 16 variables, obtained from forced choices for five categories on the survey form. These included age, sex, race, school classification, grade point average, type of school, school enrollment, frequency of science labs, number of science and math courses completed, number of microcomputers available, frequency of microcomputer use, and number of previous Olympiads attended. Figure 2 presents demographic characteristics for all students who completed the TIPS. About sixty percent were male, 69 % were juniors or seniors, 13.6 % were Black, 60.1 % had a grade-point average of 3.5 or higher, and more than half reported taking four or more science courses.

Students came to the Olympiad from a variety of local school environments. Figure 3 describes school demographics. About 43 % of the students came from rural schools. About the same fraction reported total school enrollment of less than 700. Students were asked how frequently they had laboratory experiences in their current science course. About 54 % reported labs at least every two weeks, while 28% indicated labs were conducted less than once every eight weeks. About equal numbers of students reported having no microcomputers available as those reporting ten or more microcomputers available for student use.

Results

Figure 4 presents team ranking and TIPS team averages for the 34 teams that submitted TIPS scores and participated in the Olympiad. Not all teams returned TIPS answer sheets for scoring, including the 2nd and 5th place teams. Not all of these students attended the Olympiad. Thus, correlations represent only those 404 students who took the TIPS and participated in at least one event in the Olympiad. Team points ranged from 2 to 151. The first and third place teams differed by 44 points, which represents 29.5 % of total variance. Note that there were five ties for the same total points, including a three-way tie for 20th place. These ties all occurred in a range of team points which represents only 16.7 percent of total variance.

Scores for the TIPS ranged from 11 to 36. The mean for the 462 students who took the TIPS was 25.9 (s.d.= 4.8). The median score was 26, and the mode was 30. The mean for Olympiad participants is about six points higher than that reported by Dillashaw and Okey (1980), perhaps because most of these students self-selected for interest in science. Event rankings for individuals and teams are integers in a range from one to the number of participants in each event. First place received a rank of one, second place received a two, etc. down to last place.

The first consideration for analysis was overall team performance in the Olympiad as a function of team (average) TIPS score. There were 34 paired observations of TIPS team averages with team rank. The Spearman rank-order correlation for these two variables was -0.689, which was significant at the .0001 level. This correlation is negative since highest rankings are small integers associated with the higher TIPS scores. ANOVA with 1,32 degrees of freedom yielded an F-ratio of 24.1 ($p < .0001$). The standard error of estimate was 10.7.

The second level of data analysis examined individual rankings in the Olympiad as a function of individual TIPS score. This analysis is not influenced as much by "dilution" effects of team size and performance. Spearman rank-order correlation coefficients were calculated for each individual's TIPS score with ranking in each of the Olympiad events. Results are shown in Figure 5. Rankings in five of the 22 events correlated with TIPS scores at the 0.01 level of significance. These were Bio-Process Lab, Designer Genes, Measurement Lab, Periodic Table Quiz, and Science Bowl. Three of these were individual events, while two (Measurement Lab and Science Bowl) involved team competition. Rankings in three additional events correlated with TIPS scores at the 0.05 level of significance. Two of these (A is for Anatomy and Pentathlon) were team events, while the third (Topographic Map Reading) was an individual event.

Spearman rank-order correlation coefficients were also determined for all 16 demographic variables with all 22 of the Olympiad events. Of the 352 resulting correlations, only those which were significant at the 0.05 level or better are shown in Figure 6. Since actual correlation coefficients are meaningless for forced-choice responses, they are not included in the table. Demographic variables having the greatest number of significant correlations were type of school (8), number of previous Olympiads attended (5), number of microcomputers available in school (4), and number of science courses completed (4). No significant correlations were found for age, race, grade level, or student enrollment in school. Olympiad events having the greatest number of significant correlations with student demographic variables were Science Bowl (6) and Laser Shoot (4). No significant correlations were found between demographic variables and event rankings for Circuit Lab, Computer Programming, Topographic Map Reading, Metric Estimation, and Naked Egg Drop.

Limitations

Students completed the TIPS under a teacher's supervision in their local school. Since testing conditions were not controlled, the reliability of scores is open to question. There was no explicit incentive for students to achieve at their potential on the TIPS. We made no adjustment for the effects of coaching and student rehearsal of events prior to the Olympiad. Some teams came just to have a good time, and allowed any student to enter any event, while others had practiced skills for specific events for weeks under a teacher's supervision.

Students participated as team members in more than half of the events in the Olympiad. This dilutes the validity of rankings for individuals. There is no way to assure that student achievement in the 14 team events was equally distributed among members of the team. Data analysis did not control for the number of students on a team. Yet total team points was a direct function of how many students participated in how many events. Thus, the team which ranked 19th (Figure 4) had the highest TIPS average of 31.0, but had only three members. This data point reduces the correlation between average TIPS score and team performance. The top seven ranked teams all had the maximum of fifteen team members. Individual correlation of TIPS scores with individual or sub-team performance (Figure 5) is a better measure of the predictive validity of the TIPS.

Judges' rankings were not subjected to any type of inter-rater reliability checks. While judging criteria are specified in the Olympiad Coaches Manual and Rulebook, assessments of student performance may have been different, especially across such events as "Sounds of Music" and "Bridge Building".

Conclusions

Our data indicate that the Test of Integrated Process Skills has predictive validity for student performance in selected events of the Science Olympiad. Those events which require the explicit exercise of at least two of the five integrated process skills produce the most significant correlations between individual student rankings and TIPS scores. One of these events - Bio-Process Lab - is conducted as an exercise in science process skills. It is described in the Olympiad Coaches Manual (1988) as "a lab-oriented competition involving the science processes of ... formulating and/or evaluating hypotheses and procedures, using scientific instruments to collect data, making observations, presenting and/or interpreting data, or making inferences and conclusions." (p. 33) The absence of a significant correlation between TIPS scores and the Chemistry Lab event rankings is more difficult to explain. Perhaps because technique and manual manipulation of equipment is more important in this event than in the Bio-Process Lab, the cognitive processes assessed by the TIPS are less a factor in rankings. However, such an explanation fails to account for the significant correlation between TIPS scores and rank in the Measurement Lab - an event which does require skill in the manipulation of measuring devices.

The significant correlations of TIPS with rankings in the Periodic Table Quiz and Science Bowl is probably an artifact of the large amount of common variance that has been found (Baird and Borich, 1987; Padilla, Okey and Dillashaw, 1983) between integrated science process skills and formal reasoning ability. Questions asked in these two events generally require both synthesis and analysis of concepts learned in science classes. It is likely that rankings in these events would correlate with both IQ scores and TIPS.

Results of this study provide limited support for the predictive validity of the TIPS in forecasting student performance in the Science Olympiad. Descriptions of the events and criteria for success indicate that in most cases the best correlations are consistent with those science process skills which the TIPS measures. However, demographic variables such as type of school number of previous olympiads attended, number of microcomputers available in school, and number of science courses completed are at least as strongly predictive of success in the Science Olympiad as TIPS scores. The most successful Olympiad participants were those from urban schools who had attended prior olympiads and had TIPS scores in the upper quartile. Both cognitive and cooperative skills are essential for success in the Science Olympiad.

Bibliography

______. "Science Olympiad: Coaches' Manual and Rules, Division C". National Science Olympiad Steering Committee. Rochester, MI. 1988.

AAAS. Science - A Process Approach. Washington, DC. American Association for the Advancement of Science, 1967.

Baird, W. E. and Borich, G. B. Validity considerations for research on integrated science process skills and formal reasoning ability. Science Education, 71(2) (1987), 259-269.

Berger, Carl F. Attainment of skill in using science processes. I. Instrumentation, methodology and analysis. Journal of Research in Science Teaching, 19(3) (1982), 249-260.

Brown, W. R. The effect of process skill instruction on performance of preservice elementary teachers. Journal of Research in Science Teaching, 14(1) (1977), 83-87.

Dillashaw, F. G. and Okey, J. R. Test of the integrated science process skills for secondary science students. Science Education, 64(5) (1980), 601-608.

Fritz, D. and Szabo, M. Sex, race, junior high curriculum and the acquisition of process skills. Paper presented at the annual meeting of the National Association for Research in Science Teaching, Chicago, April, 1974.

Inhelder, B. and Piaget, J. The Growth of Logical Thinking from Childhood to Adolescence. New York: Basic Books, 1958.

Johnson, D. W., Maruyama, G., Johnson. R., Nelson, D., and Skon, L. The effects of cooperative, competitive, and individualistic goal structures on achievement: A meta-analysis. Psychological Bulletin, 89(1) (1981), 47-62.

Livermore, A. H. The process approach of the AAAS Commission on Science Education. Journal of Research in Science Teaching, 2(2) (1964), 271-282.

Padilla, M. J., Okey, J. R. and Dillashaw, F. G. The relationship between science process skill and formal thinking abilities. Journal of Research in Science Teaching, 20(3) (1983), 239-246.

Padilla, M. J., Okey, J. R. and Garrard, K. The effects of instruction on integrated science process skill achievement. Journal of Research in Science Teaching, 21(3) (1984), 277-287.

Pettus, A. M. and Haley, Jr., C. D. Identifying factors related to science process skill performance levels. School Science and Mathematics, 80(4) (1980), 273-276.

Sanchez, K. and Betkouski, M. A study of factors affecting student performance in community college general chemistry courses. Paper presented at the annual meeting of the National Association for Research in Science Teaching, San Francisco, March 28 - April 1, 1986.

Shaw, M. E. A comparison of individuals and small groups in the rational solution of complex problems. Journal of Abnormal and Social Psychology, 44 (1932), 491-504.

Tannenbaum, R. The development of the test of Science Processes. Journal of Research in Science Teaching, 8(2) (1971), 123-136.

Zeitler, W. R. The influence of the type of practice in acquiring process skills. Journal of Research in Science Teaching, 18(3) (1981), 189-197.

Figure 1 - Olympiad Events

	Event Name	Type Event	Description	Scoring	Time (min.)
1)	A is for Anatomy	team (2)	Students identify anatomical structures from slides, specimens charts & drawings of human, fetal pig, rat and basic physiology .	correct total	50
2)	Balloon Race	team (2) or ind	Students attach weights to helium balloons, which must rise to the ceiling in slowest time. Teams of two or individuals may compete.	formula total	30
3)	Bio-Process Lab	individual	Lab-oriented competition using series of biological processes such testing hypotheses, using instruments, interpreting data, etc.	correct answers and technique	50
4)	Bridge-Building	team (2) or ind.	Object is to design and build the lightest bridge capable of supporting a given load over a given span using a given material.	formula total	30
5)	Calorimeter	team (2)	Team will design and build a calorimeter which will be used to determine caloric content of common food substances.	accuracy of det.	30
6)	Chemistry Lab	team (2)	Team will cooperate to answer questions or complete a task involving science processes of chemistry.	correct answers and technique	60
7)	Circuit Lab	team (2)	Team will be presented with electrical circuit and asked to predict current, voltage, and power consumption; analyze & draw diagram.	correct total	30
8)	Computer Programming	team (2)	Team must produce program code in BASIC to solve three science problems within specified time limit. Individuals may compete.	accuracy and speed	60
9)	Designer Genes	individual	Individual students solve Mendelian genetics problems relating to human genetic diseases. Knowledge of probability is essential.	correct total	40
10)	Laser Shoot	team (2)	Team must align a laser beam through a cylindrical dish and triangular prism to send the refracted beam to a fixed target.	accuracy	20
11)	Measurement	team (2)	Team measure linear, volumetric, temperature, weight, mass, current, voltage, etc. using significant figures for precision results.	number correct	30
12)	Metric Estimation	individual	Individuals estimate mass, volume, area, distance, capacity, or temperature of about 20 objects.	accuracy	20
13)	Naked Egg Drop	team (2)	Team is given one egg that they will drop into a previously prepared container. Object is minumum container height to drop height ratio.	formula ratio	60
14)	Orienteering	individual	Individual must find markers located in unfamiliar terrain, using a compass and vector headings provided.	number markers and speed	60
15)	Pentathlon	team (4)	Combination of athletic and academic competition, with 2 males and 2 females per team. Clear obstacles and answer science questions.	speed and formula	15
16)	Periodic Table Quiz	individual	Questions on factual knowledge of elements, compounds, and use of the periodic table. Participants are eliminated as in spelling bee.	by sequence of elimination	45
17)	Qualitative Analysis	team (2)	Team must identify solutes in ten numbered vials as quickly as possible, based on their reactions with each other.	total correct	50
18)	Rocks and Fossils	individual	Identify various rock, mineral, and fossil specimens, answering questions about their properties using instruments provided.	total correct	40
19)	Science Bowl	team (4)	Team competes to answer questions from biology, chemistry, physics or earth science textbooks at the appropriate level.	highest score in each round	25
20)	Sounds of Music	team (3)	Team builds musical instruments, describes principles behind their operation, and performs a musical selection on them.	formula by team of judges	20
21)	Topographic Map	individual	Map reading requires accurate interpretation of topographic map features. USGS quadrangle maps are used. Answer questions.	total correct answers	30
22)	Tree Identification	individual	Angiosperm and gymnosperm tree specimens are provided for identification using a taxonomic key.	total correct	50

Figure 2
Student Demographic Characteristics

Variable	Category	N (462)	Percent
Sex	male	268	58.6
	female	189	41.4
Classification	freshman	34	7.4
	sophmore	105	23.0
	junior	157	34.4
	senior	158	34.6
	other	3	0.7
Number of science courses completed	none	1	0.2
	one	13	2.9
	two	61	13.4
	three	145	31.9
	four or more	234	51.5
Race	Black	62	13.6
	Caucasian	362	79.2
	Asian	21	4.6
	Other	12	2.6
Grade point average (4.0 max)	Less than 2.0	27	5.9
	2.0 - 2.5	23	5.0
	2.5 - 3.0	42	9.2
	3.0 - 3.5	90	19.7
	3.5 - 4.0	274	60.1

Figure 3
School Demographic Characteristics

Variable	Category	N (462)	Percent
Type of school	small rural	111	24.6
	large rural	84	18.6
	suburban	30	6.6
	urban	168	37.2
	private	59	13.1
Student enrollment	Less than 300	77	17.0
	300 - 500	38	8.4
	500 - 700	84	18.5
	700 - 900	103	22.7
	More than 900	152	33.5
Microcomputers available for student use	none	162	35.8
	1 or 2	87	19.2
	3 to 5	15	3.3
	6 to 10	32	7.1
	more than 10	157	34.7
Frequency of labs in current science class	None	62	13.6
	Every 8 weeks	64	14.0
	Every 4 weeks	86	18.9
	Every 2 weeks	167	36.6
	Once per week	77	16.9

Figure 4
Olympiad Team Performance and TIPS Average

Team Rank	Team Points	Number on Team	TIPS Average
1	151	15	28.4
3	107	15	25.9
4	93	15	28.3
6	87	15	28.5
7	79	15	28.3
8	74	15	28.5
9	67	15	28.7
10	59	11	27.7
14	48	12	25.6
15	46	15	27.7
16	44	15	27.5
19	40	3	31.0
20	39	15	27.8
20	39	10	28.9
20	39	15	23.5
23	34	15	24.4
23	34	15	25.0
25	33	15	23.4
26	32	15	24.7
28	31	15	25.6
28	31	11	27.4
30	30	15	24.3
30	30	13	23.7
34	25	11	25.5
35	24	15	24.9
36	21	15	22.9
38	14	15	25.2
38	14	14	27.5
40	12	13	24.3
42	11	14	22.8
44	9	13	28.2
45	7	6	20.5
48	4	15	19.8
49	2	3	23.7

Figure 5

Spearman Rank Order Correlations for TIPS with Olympiad Event Rankings

Event Number	Event Name	Spearman Correlation	Number of Participants	Significance of Correlation
1	A is for Anatomy	-0.2842	57	0.032*
2	Bio-Process Lab	-0.6590	27	0.000***
3	Balloon Race	-0.0890	51	0.535
4	Bridge Building	-0.2629	29	0.168
5	Calorimeter	0.0133	35	0.910
6	Chemistry Lab	-0.1939	47	0.192
7	Circuit Lab	-0.1313	44	0.396
8	Computer Programming	-0.2625	42	0.093
9	Designer Genes	-0.6748	25	0.000***
10	Laser Shoot	-0.1419	50	0.326
11	Topographic Maps	-0.4940	20	0.027*
12	Measurement Lab	-0.3789	51	0.006***
13	Metric Estimation	-0.0244	21	0.917
14	Naked Egg Drop	-0.1397	42	0.377
15	Orienteering	0.0025	23	0.991
16	Pentathlon	-0.2018	111	0.034*
17	Periodic Table Quiz	-0.5203	31	0.003***
18	Qualitative Analysis	0.0250	32	0.892
19	Rocks and Fossils	-0.3874	21	0.083
20	Science Bowl	-0.2770	102	0.005***
21	Sounds of Music	0.0440	35	0.802
22	Tree Identification	-0.2770	21	0.224

Figure 6

Correlations of Selected Demographic Variables with Olympiad Event Rankings

(Spearman rank order correlation significances are shown in parentheses.)

Event Name	Significant Demographic Variables
A is for Anatomy	Type of school (p<.000) Number of science courses completed (p<.002) Number of previous olympiads attended (p<.000)
Bio-Process Lab	Type of school (p<.017) Number of science courses completed (p<.003) Number of previous olympiads attended (p<.003)
Balloon Race	Sex (p<.011) Frequency of microcomputer use outside school (p<.022)
Bridge Building	Type of school (p<.000) Number of microcomputers available (p<.009) Frequency of microcomputer use (p<.000)
Calorimeter	Number of microcomputers available (p<.002) Source of science skills (p<.010)
Chemistry Lab	Number of of previous olympiads attended (p<.000)
Designer Genes	Type of school (p<.018)
Laser Shoot	Type of school (p< 004) Grade-point average (p<.008) Post-graduation plans (p<.004)
Measurement Lab	Number of math courses completed (p<.015) Number of previous olympiads attended (p<.001)
Pentathlon	Type of school (p<.000)
Periodic Table Quiz	Type of school (p<.001)
Rocks and Fossils	Post-graduation plans (p<.011)
Science Bowl	Sex (p<.009) Type of school (p<.001) Number of science courses completed (p<.021) Number of previous olympiads attended (p<.012)
Sounds of Music	Sex (p<.025) Number of microcomputers available (p<.022) Frequency of microcomputer use (p<.006)